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Specification
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DEPARTMENT OF COMMERCE

BUREAU OF STANDARDS

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UNITED STATES GOVERNMENT MASTER SPECIFICATION FOR
VARNISH, SPAR, WATER-RESISTING

FEDERAL SPECIFICATIONS BOARD SPECIFICATION No. 18b

[Revised August 7, 1926]

This specification was officially promulgated by the Federal Specifications Board on February 3, 1922, for the use of the departments and independent establishments of the Government in the purchase of water-resisting spar varnish.

[The latest date on which the technical requirements of this revision shall become mandatory for all departments and independent establishments of the Government is November 7, 1926. They may be put into effect, however, at any earlier date, after promulgation.]

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I. GENERAL SPECIFICATIONS

There are no general specifications applicable to this specification.

II. GRADE

Water-resisting spar varnish for general use shall be of one grade only, as hereinafter described.

III. MATERIAL AND WORKMANSHIP

The manufacturer is given wide latitude in the selection of raw materials and processes of manufacture so that he may produce varnish of the highest quality.

IV. GENERAL REQUIREMENTS

There are no general requirements applicable to this specification.

V. DETAIL REQUIREMENTS

1. APPEARANCE.—Clear and transparent.
2. COLOR.—Not darker than a solution of 3 g of potassium dichromate in 100 cc of pure sulphuric acid, specific gravity 1.84.
3. FLASH POINT (CLOSED-CUP).—Not below 30° C. (85° F.).
4. NONVOLATILE MATTER.—Not less than 45 per cent by weight.
5. SET TO TOUCH.—In not more than five hours.
6. DRY HARD AND TOUGH.—In not more than 24 hours.
7. VISCOSITY.—Not less than 1.40 nor more than 2.25 poises.
8. WORKING PROPERTIES.—Varnish shall have good brushing, flowing, covering, and leveling properties. The dried film shall have the characteristic gloss of spar varnish.
9. SAFETY OF WORKING.—Shall pass the draft test.
10. WATER RESISTANCE.—Dried film shall withstand cold water for 18 hours and boiling water for 15 minutes without whitening or dulling.
11. TOUGHNESS.—Shall pass a 50 per cent kauri reduction test at 24° C. (75° F.).

VI. METHODS OF SAMPLING, TESTING, AND BASIS OF PURCHASE

Deliveries will, in general, be sampled and tested by the following methods, but the purchaser reserves the right to use any additional information to ascertain whether the material meets the specification.

1. SAMPLING

It is mutually agreed by buyer and seller that a single package out of each lot of not more than 1,000 packages will be taken as representative of the whole. Whenever possible an original unopened container shall be sent to the laboratory, and when for any reason this is not done the inspector shall thoroughly mix the contents of the container sampled, transfer not less than 1 quart to a clean dry glass bottle or tin can, which must be nearly filled with the sample, securely stoppered with a new clean cork or well-fitting cover or cap, sealed, and distinctly labeled by the inspector. The

inspector should take a duplicate from the container sampled to be held for check in case of dispute, and, when requested, should take a sample for the seller.

2. LABORATORY EXAMINATION

The tin panels used in the following tests shall all be cut from bright tin plate weighing not more than 25 g nor less than 19 g per square decimeter (0.51 to 0.39 pound per square foot). (Commercial No. 31 gauge bright tin plate should weigh about 0.44 pound per square foot. It is important that the tin plate used shall be within the limits set.) The panels shall be about 7.5 by 13 cm (3 by 5 inches) and must be thoroughly cleaned with benzol immediately before using.

(a) APPEARANCE.—Pour some of the thoroughly mixed sample into a clear glass bottle or test tube and examine by transmitted light. The varnish must be clear and transparent.

(b) COLOR.—Prepare a standard color solution by dissolving 3 g of pure powdered potassium dichromate in 100 cc of pure concentrated sulphuric acid of specific gravity 1.84. Gentle heat may be used if necessary to perfect the solution of the dichromate. The standard color solution and a sample of the varnish to be tested shall be placed in clear thin-walled glass tubes of the same diameter. The color comparison shall be made by placing the tubes close together and looking through them by transmitted light. The tubes used for this test should be 1.5 to 2.0 cm ($\frac{5}{8}$ to $\frac{1}{16}$ inch) in diameter and shall be filled to a depth of at least 2.5 cm (1 inch). (Since the potassium dichromate-sulphuric acid must be freshly made for this color comparison, it is frequently more convenient to compare samples with a permanently sealed tube of varnish which has previously been found to be slightly lighter in color than the standard solution of 3 g dichromate in sulphuric acid. When samples are found to be darker than this standard tube of varnish, the dichromate standard should be made up for final decision.)

(c) FLASH POINT.—Determine with either the Tag or Elliott closed-cup tester. The former is preferred.¹

(d) NONVOLATILE MATTER.—Place a portion of the sample in a stoppered bottle or weighing pipette. Weigh container and sample. Transfer about 1.5 g of the sample to a weighed flat-bottomed metal dish about 8 cm in diameter (a friction-top can plug). Weigh container again and by difference calculate the exact weight of the portion of sample transferred to the weighed dish. Heat dish and contents in an oven maintained at 105 to 110° C. (221 to 230° F.) for three hours. Cool and weigh. From the weight of the residue

¹ Directions for using the Tag tester may be found in A. S. T. M. Standards D 56-21, and directions for using the Elliott cup in Proceedings A. S. T. M., 1917, part 1, p. 414.

left in the dish and weight of the sample taken calculate the percentage of nonvolatile residue.

(e) **SETTING TO TOUCH AND DRYING TIME.**—Pour the varnish on one of the tin panels described above. Place the panel in a nearly vertical position in a well-ventilated room but not in the direct rays of the sun. The atmosphere of this room must be free from products of combustion or laboratory fumes. The temperature of the room should be from 21 to 32° C. (70 to 90° F.). The film is tested at points not less than 2.5 cm (1 inch) from the edges of the film by touching lightly with the finger. The varnish is considered to have set to touch when gentle pressure of the finger shows a tacky condition but none of the varnish adheres to the finger. The varnish is considered to have dried hard when the pressure that can be exerted between the thumb and finger does not move the film or leave a mark which remains noticeable after the spot is lightly polished. If rapid light rubbing breaks the surface, the sample is considered not to have satisfactorily dried hard. In case the test shows time of setting to touch or drying hard more than 5 and 24 hours, respectively, two additional tests shall be run on different days, and if the varnish does not meet the above drying and hardening requirements on both of these additional tests it shall be considered unsatisfactory. In cases where different laboratories fail to agree on the drying test, due to different atmospheric conditions, and umpire tests are necessary, such tests shall be made in a well-ventilated room maintained at a temperature of 70° F. and relative humidity of 65 per cent saturation.

(f) **VISCOSITY.**—Determine the viscosity of the varnish by comparison at 25° C. (77° F.) with secondary standards whose viscosity expressed in poises has been accurately determined at that temperature.²

(g) **WORKING PROPERTIES.**—Coat a smooth clean panel of metal or wood with the sample, using a good varnish brush. Observe whether the varnish shows objectionable "pulling" under the brush and whether the varnish film levels and yields a surface of good appearance.

(h) **SAFETY OF WORKING.**—*Draft test.*—Flow the varnish on one of the standard tin panels and immediately place the panel in the direct draft of a small (8 or 10 inch) electric fan running at full speed. The panel should be placed approximately 2 feet from the fan in a nearly vertical position and at an angle of 45° to the line of the air current. Allow the panel to remain in this position for five hours, remove, and allow to harden overnight. The varnish shall show no dulling, crow's footing, or frosting. This test shall be

² Gardner-Holdt tubes may be used, in which case the limits are tube "F" to "I," inclusive. See Circular No. 178, Scientific Section, Paint Manufacturers' Association of the United States.

made under the same room and temperature conditions noted under "Setting to touch and drying time," Section VI, 2, (e).

(i) **WATER RESISTANCE.**—Pour the varnish on two of the tin panels described above and allow to dry under the conditions described in paragraph (e) for 48 hours. Place one of these panels in a beaker containing about 2.5 inches of distilled water at room temperature (immersing the end of the panel which was uppermost during the drying period) and leave in water for 18 hours. The varnish shall show no whitening and no more than very slight dulling either when observed immediately after removing from the water or after drying for two hours. Place the other panel in a beaker containing about 2.5 inches of boiling distilled water (immersing the end of the panel which was uppermost during the drying period) and allow to remain in the boiling water for 15 minutes. The varnish shall show no whitening and no more than a very slight dulling either when observed immediately after removing from the water or after drying for two hours.

(j) **TOUGHNESS.**—The toughness of the varnish is determined by the Kauri reduction test, as follows: By proportionately reducing its toughness by the addition of a standard solution of "run-Kauri" gum in pure spirits of turpentine.

(1) *Preparation of the "run Kauri."*—Arrange a distillation flask, water-cooled condenser, and a tared receiver on a balance. Place in the flask about one-third of its volumetric capacity of clear, bright hard pieces of Kauri gum broken to pea size. Carefully melt and distill until 25 per cent by weight of the gum taken is collected in the tared receiver. Pour the residue into a clean pan and when cold break up into small pieces.

(2) *Preparation of standard "run Kauri" solution.*—Place a quantity of the small broken pieces of run Kauri, together with twice its weight of freshly redistilled spirits of turpentine, using only that portion distilling over between 153 and 170° C. (308 and 338° F.) in a carefully tared beaker. Dissolve by heating to a temperature of about 149° C. (300° F.) and bring back to correct weight when cold by the addition of the amount of redistilled spirits of turpentine necessary to replace the loss by evaporation during the dissolving of the gum.

(3) *Reduction of the varnish.*—Having carefully determined the nonvolatile content of the varnish according to the method under paragraph (d) of this specification, take 100 g of the varnish and add to it an amount of the standard run-Kauri solution equivalent to 50 per cent, by weight, of the nonvolatile matter in the varnish. Mix the varnish and the solution thoroughly.

(4) *Application of the varnish.*—Flow a coat of the varnish thus reduced on one of the tin panels described above and let stand in a

nearly vertical position at room temperature for one hour. Next place the panel in a horizontal position in a properly ventilated oven and bake for five hours at 95 to 100° C. Remove the panel from the oven and allow to cool at room temperature, preferably 24° C. (75° F.) for one-half hour.

(5) *Bending the panel.*—Place the panel with the varnished side uppermost over a 3 mm ($\frac{1}{8}$ -inch) rod, held firmly by suitable supports, at a point equally distant from the top and bottom edges of the panel and bend the panel double rapidly. The varnish must show no cracking whatsoever at the point of bending. For accurate results the bending of the panel should always be done at 24° C. (75° F.), for a lowering of the temperature will lower the percentage of reduction that the varnish will stand without cracking, while an increase in the temperature increases the percentage of reduction that the varnish will stand.

3. BASIS OF PURCHASE

Varnish shall be purchased by volume, the unit being a gallon of 231 cubic inches at 15.5° C. (60° F.). The volume may be determined by measure, or, in case of large deliveries, it may be easier to determine the net weight and specific gravity at 15.5/15.5° C. (60/60° F.) of the delivery. The weight per gallon in pounds can then be determined by multiplying the specific gravity by 8.33. The net weight in pounds divided by the weight per gallon gives the number of gallons.

VII. PACKING

Packing shall be in accordance with commercial practice unless otherwise specified.

VIII. NOTES

Water-resisting spar varnish is intended to meet all the needs of the Government for a general utility varnish, suitable for both outside and inside exposure, where durability is the chief requisite and where high gloss or initial hardness of the film are not required. It does not, however, fulfill all the requirements for an aircraft varnish.

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